

Not All Noise Is the Same: Fluctuations in Transportation Noise Levels and Arterial Stiffness

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An accumulating body of epidemiological evidence has related transportation noise to cardiovascular disease (CVD).^{1,2} A new study in *Environmental Health Perspectives* provides early evidence for a relevant step in disease development: namely, that residential exposure to transportation noise may be associated with arterial stiffness, a significant risk factor of future CVD.³ Furthermore, the potential impact of transportation noise on arterial stiffness may depend not only on the overall noise level but also on the recurrence of isolated loud noises during the nighttime.

Evidence from experimental studies has shown that acute sleep disturbances can increase levels of stress hormones, raise blood pressure and heart rate, and possibly even alter endothelial function (a precursor of atherosclerosis).^{4,5} This evidence suggests one plausible mechanism behind the CVD–noise relationship: that repeated triggering of the autonomic nervous and endocrine systems, particularly during sleep, leads to chronic dysregulations in the cardiovascular system.⁶ Additional mechanisms might involve oxidative stress or impairment of the immune system, which could also contribute to cardiovascular and metabolic alterations.⁶

The authors of the present paper used data from the population-based Swiss Cohort Study on Air Pollution and Lung and Heart Diseases in Adults (SAPALDIA) to evaluate the relationship

between noise and arterial stiffness in humans. The study, which was led by senior author Nicole Probst-Hensch, collected baseline data in 1991 from a random sample consisting of 9,651 adults 18–60 years old who were living across Switzerland. Follow-ups occurred in 2001–2003 and in 2010–2011. During the second follow-up, arterial stiffness was measured as brachial-ankle pulse wave velocity in a sample of 3,086 people 50 years of age and older.

For each residence, the authors estimated average annual levels of noise from roads, airways, and railways; the total annual average number of isolated loud noise events that stood out from background noise; and the “intermittency ratio” of noise levels from isolated events to the overall noise level. This information enabled them to evaluate whether overall noise levels fluctuated (high intermittency) or stayed constant (low intermittency) over a period of time.

The authors reported an association between arterial stiffness and the total number of nighttime noise events, which were mostly related to roadways. Only in urban areas did they also find an association between annual average roadway noise levels and arterial stiffness. This may reflect the fact that urban participants tended to live closer to roads, where noise events might be better distinguished from background noise.



Intermittent railway noise and a high number of roadway-related noise events at night may be particularly harmful forms of noise pollution as far as cardiovascular health is concerned. Image: © pisaphotography/Shutterstock.

The authors also found associations between arterial stiffness and estimated exposure to annual average railway noise levels. Associations were stronger when participants were exposed to highly intermittent noise at night than when they were exposed to more constant noise. “It was interesting and surprising to see that railway noise was the source most clearly associated with arterial stiffness. This could be partly due to its intermittent nature, with loud noise events that stand out from the background,” says first author Maria Foraster, an epidemiologist at the Swiss Tropical and Public Health Institute.

Although aircraft noise also occurs intermittently, it was not associated with arterial stiffness in this study. The authors suspect this lack of association might be related to curfews on nighttime aircraft operations in Switzerland. They also reported no associations with daytime noise events.

“A key potential confounder—traffic-related air pollution—was accounted for, as were other individual-level risk factors like active and passive smoking and diet,” says Patricia Coogan, senior epidemiologist at the Slone Epidemiology Center at Boston University, who was not involved in the study. “The study makes an important contribution because of the integrated way of assessing noise from all major transportation sources and the attention to different aspects of noise exposure.” Coogan says noise is an underappreciated source of stress in modern life as fewer and fewer quiet spaces are available.

A longitudinal study would allow researchers to better assess causality in the relationship between transportation noise and arterial stiffness, as well as future CVD. “Future studies could also look at additional biomarkers of CVD,” Foraster says. She

explains that diverse biomarkers can give information about the involvement of pathways such as inflammation and oxidative stress, reactions of the autonomic nervous system, metabolic regulation, and sleep patterns. Understanding such pathways is one of the aims of SAPALDIA.

Wendee Nicole has written for *Discover*, *Scientific American*, and other publications.

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